

Is it Necessary to Incorporate Transient-Flow Processes in Model Simulations?: An Example From a River-Valley Aquifer

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Model complexity is routinely considered a function of the complexity of the features of the physical system -- such as aquifer heterogeneity, geometry, and boundary conditions -- and the discretization of these features into a model. However, the physical system can also be complex in terms of changes through time in natural and anthropogenic stress patterns and their effect on ground-water flow and transport. The degree to which transient processes are simulated in models, in addition to reasons related to improved model calibration, depends on the purpose and scope of the simulations as well as the response of the system to transient stresses.

The results of a simulation that considers the effects of temporal changes in recharge, ground-water withdrawals, and river stage were compared to the results of an average steady-state simulation of flow to ascertain the importance of transient-flow processes on the advective transport of contaminated ground water and on proposed remedial schemes for a permeable, glacial-drift, river-valley aquifer. Simulation results showed that the location of pathlines of contaminated ground water shifted by 1,200 feet as a consequence of long-term changes in withdrawals but typically less than 100 feet in response to changes in seasonal conditions. The average velocity of ground waters varied by a factor of two due to changes in seasonal conditions in areas of the aquifer near boundary conditions and/or internal sinks. In other areas, seasonal conditions had negligible effect on advective transport.

This study indicates that the degree to which simulation of transient processes improves results of simulation of field conditions is spatially dependent. The location of boundaries and internal sinks with respect to critical flowpaths must be carefully assessed to determine whether the added complexity of transient simulations is needed.

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